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MILITARY SPECIFICATION

COATING, URETHANE, ALIPHATIC ISOCYANATE, FOR AEROSPACE APPLICATIONS

* 1. SCOPE

1.1 Scope. This specification establishes requirements for two component aliphatic isocyanate based oil free urethane coating materials suitable for exterior application on aerospace equipment. The type I and type II coatings are suitable for use under local AIR POLLUTION CONTROL REGULATIONS.

* 1.2 Classification

1.2.1 Components. The aliphatic urethane coating shall consist of the following components, as specified: (see 3.2).

Component I - shall consist of pigmented polyester resin.

Component II - shall consist of clear aliphatic isocyanate.

1.2.2 Types. The coating material shall be furnished, as specified:

Type I - suitable for application by conventional pressurized air spray techniques.

Type II - suitable for application by unheated, airless spray techniques.

1.3 Colors. The coating shall be furnished in any color and gloss range, as designated in FED-STD-595. Limited special colors shall be furnished, as specified by the procuring activity. Following is a list of colors most frequently required.

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	<u>FED-STD-595</u> <u>Color Number</u>	<u>Color Name</u>
a. Gloss Colors:	-	Clear
	11136	Insignia Red
	12197	International Orange
	13538	Orange Yellow
	13655	Yellow
	15044	Insignia Blue
	15450	Air Superiority Blue
	16081	Engine Gray
	16440	Light Gray
	16473	Aircraft Gray
	17038	Gloss Black
	17875	Insignia White (Untinted)
b. Camouflage Colors:	30140	Brown Special
	30219	Tan
	30279	Sand (Desert Pink)
	31136	Insignia Red
	33538	Orange Yellow
	34079	Dark Green
	34087	Green
	34102	Olive Drab (Green)
	35044	Blue
	35450	Air Superiority Blue
	36622	Gray
	37038	Black
	37875	White
	20400	Tan Special (see 6.5)
	34201	Greenish Tan (see 6.5)
	32159	Blueish Green

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-A-250/5	Aluminum Alloy, Alclad 2024, Plate and Sheet
QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet

TT-P-143	Paint, Varnish, Lacquer and Related Materials; Packaging, Packing and Marking
TT-S-735	Standard Test Fluids; Hydrocarbon
UU-T-106	Tape, Pressure-Sensitive Adhesive, Masking, Paper

Military

MIL-H-5606	Hydraulic Fluid, Petroleum Base; Aircraft and Ordnance
MIL-P-23377	Primer Coating; Epoxy-Polyamide, Chemical and Solvent Resistant
MIL-C-25769	Cleaning Compound, Aircraft Surface, Alkaline Waterbase
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-T-81772	Thinner, Aliphatic Polyurethane Coating

STANDARDS

Federal

Fed. Test Method Standard No. 141	Paint, Varnish, Lacquer and Related Materials; Method of Inspection, Sampling and Testing
FED-STD-595	Colors

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-109	Quality Assurance Terms and Definitions
MIL-STD-129	Marking for Shipment and Storage

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM)

B-117	Salt Spray (Fog) Testing
D-562	Consistency of Paints
D2369	Volatile and Nonvolatile Content
D2267	Method of Test for Aromatics in Light Naphthas, Reformates, and Gasolines by Gas Chromatography
D1738	Hiding Power of Nonchromatic Paints

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pennsylvania 19103.)

U. S. Department of Health, Education and Welfare

Federal Hazardous Substances Labeling Act

(Application for copies should be addressed to the U. S. Department of Health, Education and Welfare, Food and Drug Administration, Washington, D. C. 20203.)

3. REQUIREMENTS

3.1 Qualification. The coating materials furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein and has been listed or approved for listing on the applicable Qualified Products List.

3.2 Materials. The urethane coating shall consist of two basic components: a resin base component, Component I, and an aliphatic isocyanate reactant component, Component II. These two basic components will contain the solvents, pigments, and other necessary additives to enable the product to conform to the requirements specified herein.

3.3 Pollution Control Restrictions. The solvents used in Component I and Component II must be certified to meet local air pollution control regulations of the geographic area in which the coating is to be applied (see 4.8.1).

3.4 Toxic products and formulations. The toxic characteristics of the material shall be properly identified and defined to enable establishment of adequate safeguards and procedures to prevent adverse effects on the health of personnel testing or applying the material and persons in adjacent areas (see 4.8.2).

3.5 Component requirements

3.5.1 Components. The aliphatic polyurethane paint shall consist of two components. Component I shall be the pigmented polyester resin. Component II shall be the clear aliphatic isocyanate. These shall be individually packaged and furnished as a kit. The mixing ratio of the coating material shall be one volume of component II to one volume of component I.

3.5.1.1 Aliphatic Isocyanate. Component II of the polyurethane coating shall contain aliphatic isocyanates only. This shall be determined in accordance with 4.8.8.

3.5.2 Solvents. The solvents contained in the packaged paint shall be urethane grade and shall be nonphotochemically reactive to meet the existing air pollution regulations of some geographical areas when tested in accordance with 4.8.3.

3.5.3 Thinners. The aliphatic polyurethane shall be compatible with thinner meeting the requirements of MIL-T-81772, which is nonphotochemically reactive. The solvent mixture of table I may also be used to thin the aliphatic polyurethane coating.

TABLE I

Nonphotochemical reactive materials 1/

Solvent	Percent by volume
Methyl Ethyl Ketone	30 \pm 1
N-Butyl Acetate	10 \pm 1
Cellosolve Acetate	40 \pm 1
Toluene	12 max
Xylene	8 max

1/ The solvents shall be urethane grade, free from water and alcohol.

3.5.4 Nonphotochemically reactive solvent. The nonphotochemically reactive solvents of the coating material shall not exceed any one of the following percentage composition limitations with reference to the total volume of the solvent when tested in accordance with 4.8.3 and table V.

- a. A combination of hydrocarbons, alcohols, aldehydes, esters, ethers or ketones having an olefinic or cyloolefinic type of unsaturation: 5 percent.
- b. A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene: 8 percent.
- c. A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichlorethylene or toluene: 20 percent.

3.5.5 Condition in container. Freshly opened full containers of component I of the coating material shall be free from lumps, skins, grit and coarse particles and shall show no more settling than can be dispersed by five minutes of agitation on a Red Devil, or equivalent, type paint shaker to a smooth homogeneous condition, when tested as specified in 4.8.3 and table V. Component II shall be clear, clean and free of any moisture contamination as evidenced by white flocculent resinous precipitates.

3.5.6 Moisture content. Component I of the gloss coating material shall not contain more than 0.50 percent by volume of water when tested in accordance with 4.8.3 and table V. Component I of the semigloss and camouflage coating materials shall not contain more than 0.75% by volume of water when tested in accordance with 4.8.3 and table V.

3.5.7 Viscosity, Stormer (Component I). The viscosity (consistency) of component I of the coating material for gloss colors shall be a minimum of 85 Kreb Units and a maximum of 95 Kreb Units (KU) when tested in accordance with 4.8.3 and table V. The viscosity (consistency) of component I of the coating material for camouflage colors shall be a minimum of 95 Kreb Units and a maximum of 110 Kreb Units except for camouflage black which may be a maximum of 115 Kreb Units when tested in accordance with 4.8.3 and table V.

3.5.8 Storage stability. The previously unopened packaged components shall meet all the requirements specified herein after storage period of one year, provided that the daily mean temperature of the ambient air at the storage locations falls within the range of 0°F to 115°F (see 4.8.4).

3.6 Mixed coating requirements

3.6.1 Working properties and surface appearance. Spray coats of the mixed coating, comprising the two components mixed in the ratio of one part by volume of component I, to one part by volume of component II, and thinned, if required, to meet viscosity as specified in 3.6.3 with thinner conforming to MIL-T-81772, shall be smooth, uniform and free of bubbles, pinholes, holidays, and other film irregularities. The spray applied films, dried under the conditions specified in 4.6.1, shall provide a hard surface, free from grit, seeds, streaks, orange-peel, blisters, or other surface defects when observed as indicated in 4.8.3 and table V.

3.6.2 Drying time. The dry time of the coating applied in accordance with 4.7, shall not exceed 2 hours for the set-to-touch condition, one hour for the dry-to-recoat condition, nor 6 hours for the dry-hard condition when tested in accordance with 4.8.3 and table V.

3.6.3 Viscosity. The viscosity of the freshly mixed material shall be 17 to 23 seconds in a number 2 Zahn cup when measured in accordance with 4.8.9. After standing for 6 hours the viscosity shall not increase greater than 20 percent from the original viscosity.

3.6.4 Settling. When tested as specified in 4.8.3 and table V after standing undisturbed for 6 hours, the mixed and reduced coating material shall be free of curdling, precipitation and separation which cannot be easily redispersed by shaking on a mechanical paint mixer.

3.6.5 Odor. The odor of the coating material shall not be obnoxious, when tested in accordance with 4.8.3 and table V.

3.6.6 Free diisocyanate. The free diisocyanate in the mixed coating shall not exceed 1 percent when tested in accordance with appendix I.

3.6.7 Pot life. The coating material after mixing and reducing for spray application shall have a minimum pot life of 6 hours. After standing for 6 hours as specified in 4.8.5, the material shall conform to the requirements specified in 3.6.2, 3.6.3, 3.7.1.2, 3.7.2.2, and 3.7.3.5.a.

3.6.8 Fineness of grind. The fineness of grind of the mixed paint shall not be less than 7 for the gloss coatings and not less than 5 for the camouflage coatings. The tests shall be made 1 hour after mixing, in accordance with 4.8.3 and table V.

3.6.9 Nonvolatile (solids) content. The total nonvolatile solids for the admixed components of gloss colors shall be a minimum of 52 percent except black, insignia red, insignia blue and clear which shall be a minimum of 35 percent. The total nonvolatile solids content for the admixed components of camouflage and semigloss colors shall be 45 percent except black, insignia red, insignia blue and clear which shall be a minimum of 35 percent. Solids content shall be determined in accordance with 4.8.3 and table V.

3.7 Applied film property requirements

3.7.1 Optical properties

3.7.1.1 Color. The color of the coating applied in accordance with 4.7, after drying 48 hours at standard conditions, shall match the Federal Standard 595 chip required in 6.2, when tested as indicated in 4.8.3 and table V.

3.7.1.2 Gloss. The specular gloss of the spray applied coating measured in accordance with 4.8.3 and table V, 48 hours after application shall be as specified in table II.

TABLE II

Specular gloss, 60 degrees

	Maximum	Minimum
Gloss Colors	-	90
Camouflage Colors	12	7

3.7.1.3 Hiding power. The minimum contrast ratio of the coating at a maximum dry film thickness of 0.002 inch shall be as follows: white and light tints 0.85, red and maroon 0.90, and all other colors 0.95, when tested in accordance with 4.8.3 and table V after curing for 24 hours at standard conditions in a dust-free cabinet.

3.7.2 Physical properties

3.7.2.1 Wet tape adhesion. After curing for 72 hours at standard conditions, the coating applied to panels in accordance with 4.7 shall be tested in accordance with 4.8.3 and table V, with no loss of adhesion between coats, between topcoat and primer, or between primer and metal substrate.

3.7.2.2 Impact flexibility. The applied films of gloss and camouflage colors shall meet the flexibility requirements of table III. Panels for this test shall be 3 by 3 by 0.20 inch, 2024-T0 alclad aluminum which has been prepared and coated in accordance with 4.7. The test procedure shall be in accordance with 4.8.3 and table V with the exception that the impacting mandrel shall be dropped from a height of 24 inches as measured from the impacting surface of the mandrel to the surface of the coated test panel. The elongated surfaces of the impacted coated panels shall be examined under 10X magnification for cracking and crazing of the coating immediately after testing and 72 hours after test. The presence of cracking or crazing at either evaluation period shall constitute failure. Adhesion of the coating to the elongated surfaces of the impacted panels shall be determined by placing masking tape conforming to UU-T-106 over the elongated surface, insuring that the tape is well adhered, and then removing the tape with one abrupt pull. Any paint removal shall constitute failure.

TABLE III

Impact flexibility requirements

Test Condition	Materials	
	Gloss colors	Camouflage colors (percentage)
A After 8 hours dry time and normal 7 days cure at standard conditions.	60	20
B After 8 hours dry time, normal 7 days cure at standard conditions, and aging 4 hours at 300°F	60	20
C After 8 hours dry time, normal 7 days cure at standard conditions and 500 hours weatherometer exposure. (300 hours for quality acceptance)	60	20
D After 8 hours dry time, normal 7 days cure at standard conditions and 24 hours immersion in diester lubricating oil at 250° ± 5°F.	60	20
E After 1 year weather exposure	60	20

3.7.3 Resistance properties

3.7.3.1 Salt spray resistance. Three test panels prepared in accordance with 4.7 and exposed to 5 percent salt spray for 500 hours as specified in 4.8.3 and table V shall exhibit no corrosion.

3.7.3.2 Humidity resistance. Three test panels prepared in accordance with 4.7 and exposed in the humidity chamber for 30 days at 95 percent RH minimum and $120^{\circ}\text{F} \pm 2^{\circ}\text{F}$ as specified in 4.8.3 and table V shall exhibit no loss of adhesion, blistering, softening, or other evidence of film failure when inspected immediately after removal from the test conditions.

3.7.3.3 Heat resistance. Test panels prepared in accordance with 4.7 and exposed vertically to dry heat for 4 hours at 300°F (158.9°C) shall meet the requirements specified in 3.7.1.2, 3.7.2.2 and test condition B of table III. Slight yellowing and darkening shall not constitute failure.

3.7.3.4 Low temperature resistance. Test panels prepared in accordance with 4.7, with the exception that the chemical film treatment shall be omitted on the two panels for this test (see 4.7.2), and coated with gloss material and exposed as specified in 4.8.6 shall show no failure upon bending around a 3/8-inch diameter cylindrical mandrel. Test panels prepared in accordance with 4.7, with the exception that the chemical film treatment shall be omitted on the two panels for this test (see 4.7.2), and coated with camouflage material and exposed as specified in 4.8.6 shall show no failure upon bending around a 1/2-inch diameter cylindrical mandrel.

3.7.3.5 Fluid immersion resistance. When tested as specified in 4.8.3 and table V, panels prepared in accordance with 4.7 and exposed to the fluids as specified below shall show no pigment leaching, loss of adhesion or corrosion. A decrease of more than one pencil hardnesses from the original hardness value of the coating material exposed to fluids and test conditions in a, b, c and e below shall constitute failure when tested in accordance with 4.8.12 and Figure 1. Panels exposed to the fluid and test condition "a" shall meet flexibility requirements of table III. A decrease of more than two pencil hardnesses from the original hardness value of the coating material exposed to the fluid and test condition in d below shall constitute failure when tested in accordance with 4.8.12 and Figure 1. Slight visible staining shall not constitute failure. Slight staining for the purpose of this specification is defined as that discoloration which is visually detectable when the exposed coating is compared to an unexposed coated panel of the same material. Panels shall be inspected immediately upon removal from the test fluids for the presence of any observable defects. The exposed panels shall then be cleaned and all specified tests

performed within one hour after removal from the test fluids. Cleaning of the panels shall be by wiping with lint free paper towels or cloth and then washing in detergent conforming to MIL-C-25769 or equivalent, rinsed in distilled water and dried with clean lint free paper towels or cloth.

a. Lubricating oil resistance. Diester lubricating oil composed of 98 percent diisooctyl adipate, and 2 percent tricresyl phosphate, by weight, at a temperature of $250^{\circ} \pm 4^{\circ}\text{F}$ ($121^{\circ} \pm 2^{\circ}\text{C}$) for a period of 24 hours.

b. Hydrocarbon resistance. Type III fluid of TT-S-735 for a period of 7 days at standard conditions.

c. Hydraulic fluid resistance. Hydraulic fluid of MIL-H-5606 for a period of 7 days at standard conditions.

d. Skydrol 500B hvdraulic fluid. Skydrol 500B fluid for a period of 7 days at standard conditions.

e. Distilled water resistance. Distilled water at 100°F (37.8°C) for a period of 4 days.

3.7.3.6 Weather resistance

3.7.3.6.1 Accelerated weathering. The coating material shall be exposed for 500 hours for initial qualification testing and 300 hours for quality acceptance testing. Panels prepared in accordance with 4.7 shall be exposed for the times specified above in an enclosed twin carbon arc accelerated weathering unit operated on a continuous cycle wherein the coating films are exposed to 102 minutes of light without water and 18 minutes of light with water spray as specified in 4.8.3 and table V. After exposure, the coating shall meet the impact flexibility requirements of table III, test condition C and shall exhibit no evidence of deterioration or failure such as cracking, checking or loss of adhesion. A 10 percent loss of gloss from the original unexposed coating is permitted for all gloss ranges of the material. (See Table II). Slight color change of the exposed panels is acceptable. "Slight" is defined as that color change which is visually detectable when compared to the standard color chip and the same unexposed coating material and can be considered a minor but acceptable color change as determined by the qualifying or procuring activity. Prior to measuring the gloss, the exposed panels shall be lightly cleaned in a dilute solution of detergent conforming to MIL-C-25769, or equivalent, in distilled or deionized water, rinsed in distilled

or deionized water and then blotted dry with clean lint free paper or cloth toweling. The panels shall then be dried at standard conditions for one hour before measuring the gloss.

3.7.3.6.2 Outdoor weathering. Coated test panels prepared in accordance with 4.7 and exposed as specified in 4.8.7 shall meet the impact requirements of Table III, test condition E and shall exhibit no evidence of deterioration or failure such as cracking, checking or loss of adhesion. A 10 percent loss of gloss from the original unexposed panel is permitted for all gloss ranges of the material. (See Table II). Slight color change of the exposed panels is acceptable. "Slight" is defined as that color change which is visually detectable when compared to the standard color chip and the same unexposed coating material and can be considered a minor but acceptable color change as determined by the qualifying or procuring activity. Prior to measuring the gloss, the exposed panels shall be lightly cleaned in a dilute solution of detergent conforming to MIL-C-25769, or equivalent, in distilled or deionized water, rinsed in distilled or deionized water, and then blotted dry with clean lint free paper or cloth toweling. The panels shall then be dried at standard conditions for one hour before measuring the gloss.

3.7.3.7 Resistance to taping. All colors and gloss ranges of the polyurethane coating except blacks shall be sufficiently cured after 6 hours drying time at standard conditions to permit taping without permanent marring of the painted surface. All gloss ranges of the blacks shall be sufficiently cured after 16 hours drying time at standard conditions to permit taping without marring of the painted surface. Resistance to taping shall be tested in accordance with 4.8.10.

3.8 Workmanship. The component ingredients shall be intimately assembled and processed as required in accordance with the best practice for the manufacture of a high quality coating.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.2 Classification tests. The inspection and testing of the urethane coating shall be classified as follows:

- a. Qualification inspection (4.3).
- b. Quality conformance inspection (4.4).

4.2.1 The inspection terms used herein are defined in MIL-STD-109.

4.3 Qualification inspection. Qualification inspection shall consist of all inspections and tests specified herein.

4.3.1 Qualification samples. The test samples shall consist of three (3) one-quart kits of the coating material. The material shall be furnished in containers of the type to be used in filling contract orders. Samples shall be identified as follows and forwarded to the activity responsible for testing, as designated in the letter of authorization from the activity responsible for qualification (see 6.3).

- Samples for qualification tests.
- Coating, Urethane, Aliphatic Isocyanate, For Aerospace Application.
- MIL-C-83286B
- Manufacture's Code No.
- Name of Manufacture.
- Submitted by (Name) (date) for qualification tests in accordance with the requirements of MIL-C-83286A under Authorization (reference authorizing letter).
- Mixing and other important instructions.

4.3.1.1 Test report. In addition to the qualification test samples, the manufacturer shall furnish a test report showing that the material satisfactorily conforms to this specification.

4.4 Quality conformance tests. Quality conformance tests for acceptance of coatings shall consist of all the tests of this specification except that artificial weathering exposure for quality conformance shall be 300 hours (see 3.7.3.6.1) and with the exception of the following examinations and tests:

- a. Storage life.
- b. Outdoor weathering.

4.4.1 Sampling. Unless otherwise specified (see 6.2), not less than a one (1) gallon kit of coating material shall be selected at random from each batch and subjected to the tests specified in 4.4.

4.4.1.1 Batch. A batch shall consist of all coating material manufactured during one continuous operation, forming part of one contract or order for delivery.

4.4.2 Sampling for examination of product. Sampling for filled containers shall be in accordance with MIL-STD-105, Level II, AQL 1.5 percent defective. The sample containers shall be subjected to the inspection specified in 4.8.11.

4.4.3 Rejection and retest. Rejected material shall not be resubmitted for acceptance without prior approval of the procuring activity. The application for resubmission shall contain full particulars concerning previous rejections and measures taken to correct these defects. Samples for retest shall be taken from previously unopened containers.

4.5 Toxicological data and formulations. The supplier shall furnish the toxicological data and formulations required to evaluate the safety of the coating materials for the proposed use.

4.6 Test conditions

4.6.1 Standard conditions. Standard conditions shall be a temperature of $77^{\circ} \pm 2^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$), and a relative humidity of 50 ± 5 percent. All tests shall be conducted at standard conditions unless otherwise specified herein. (See Fed. Test Method Std. No. 141, Section 7, Paragraph 1.2).

4.7 Test panels. Except as otherwise specified in the test methods of 4.8 all test panels shall be of clad aluminum alloy conforming to QQ-A-250/5 of the size, heat treatment and quantity specified in table IV. The panels shall be cleaned, pretreated and primed as specified in 4.7.1, 4.7.2 and 4.7.3, respectively.

4.7.1 Cleaning. All test panels shall be cleaned in accordance with the procedure specified for non-anodized aluminum panels in Fed Test Method Std. Nr. 141, Method 2013, Table II.

4.7.2 Pre-treatment. All test panels, except the two (2) panels for the low temperature flexibility requirement of 3.7.3.4 shall be given a chemical film treatment conforming to type II of MIL-C-81706. Omit the chemical film treatment for the two (2) low temperature test panels only.

4.7.3 Priming. All test panels shall be primed with epoxy polyamide primer conforming to MIL-P-23377. The primer shall be applied to a dry film thickness of 0.6 mils to 0.9 mils and air dried for a minimum of 3 hours and a maximum of 4 hours before topcoating.

4.7.4 Top coat application. The two components of the urethane coating under test shall be mixed (one volume of component I by volume with one part by volume of component II), and reduced in accordance with the manufacturer's instructions to a viscosity of 17 to 23-seconds when measured as specified in 4.7 for spray applications. The viscosity should be suitably adjusted for other methods of application. The coating shall be applied to a total dry film thickness of 2.0 ± 0.3 mils in two coats. The total dry film thickness of the primer and coating shall be 2.6 to 3.2 mils. After application of the first coat, the panels shall be air dried in a horizontal position in a dust-free cabinet at standard conditions until sufficiently dry for application of the second coat. Dry to recoat shall not exceed one hour. An average of 5 film thickness measurements shall be taken in the central portion of the coated panels with a suitable filmeter. Unless otherwise specified, the coated test panels shall be air cured at standard conditions for 168 hours after application of the second coat prior to any testing.

4.8 Test methods

4.8.1 Air pollution control regulations. The manufacturer will furnish the solvent and thinner combination by weight percentage for the coating he plans to submit along with the local pollution control authority certification to the Government Laboratory (see 6.3).

4.8.2 Toxicological data and formulations. The manufacturer will furnish the toxicological data or formulations required to evaluate the toxicology of the coating material to the Government Laboratory (see 6.3) which will refer the data to the appropriate medical service for determination and approval.

4.8.3 General test methods. The methods of Fed. Test Method Standard No. 141 referenced in table V are to be used to evaluate the urethane coating material.

4.8.4 Storage stability. A full, closed container of components I and II shall be stored under warehouse conditions at a temperature of 70° to 90°F (21.1° to 32.2°C) for one year, after which it shall be opened and inspected and tested for conformance to the requirements of this specification (see 3.5.7).

TABLE IV

Test panel plan				
Test paragraph	Test requirement	Panel size in inches	Aluminum alloy and heat treatment	Quantity of panels required
3.6.1	Working properties	3X6X0.020	Clad 2024-T3	2
3.7.1.1.1	Color	3X6X0.020	Clad 2024-T3	Use panels from 3.6.1
3.6.2	Drying time	3X6X0.020	Clad 2024-T3	Use panels from 3.6.1
3.6.7	Pot life	3X6X0.020	Clad 2024-T0	4
3.7.2.1	Wet tape adhesion	3X6X0.020	Clad 2024-T3	2
3.7.2.2a	Impact flexibility	3X6X0.020	Clad 2024-T0	2
3.7.2.2b	Impact flexibility	3X6X0.020	Clad 2024-T0	see 3.7.3.3
3.7.2.2c	Impact flexibility	3X6X0.020	Clad 2024-T0	see 3.7.3.6.1
3.7.2.2d	Impact flexibility	3X6X0.020	Clad 2024-T0	below
3.7.2.2e	Impact flexibility	4X6X0.020	Clad 2024-T0	see 3.7.3.5.a
3.7.3.1	Salt spray resistance	3X6X0.020	Clad 2024-T3	below
3.7.3.2	Humidity resistance	3X6X0.020	Clad 2024-T3	3
3.7.3.3	Heat resistance	3X6X0.020	Clad 2024-T3	3
3.7.3.4	Low temp. flexibility	3X6X0.020	Clad 2024-T0	2
3.7.3.5a	Lub oil resistance	3X6X0.020	Clad 2024-T0	2
3.7.3.5b	Hydrocarbon resistance	3X6X0.020	Clad 2024-T0	2
3.7.3.5c	Hydraulic fluid resistance	3X6X0.020	Clad 2024-T3	2
3.7.3.5d	Skydrol 500B resistance	3X6X0.020	Clad 2024-T3	2
3.7.3.5e	Distilled water resistance	3X6X0.020	Clad 2024-T3	2
3.7.3.6.1	Accelerated weathering	2.75X8X0.020	Clad 2024-T0	3
3.7.3.6.2	Outdoor weathering	4X6X0.020	Clad 2024-T0	3
TOTAL				38

4.8.5 Pot life. A one pint sample of mixed and reduced coating material shall be stored in a full, closed container at standard conditions for a period of 6 hours. At the end of the 6 hour period, the coating shall be examined for lumping, seeding, and separation. It shall then be tested for conformance to the requirements of 3.6.7.

4.8.6 Low temperature resistance. Panels prepared in accordance with 4.7 and cured in accordance with 4.6 and the cylindrical mandrels shall be placed in a cold box maintained at $-65^{\circ}\text{C} \pm 3^{\circ}\text{F}$ ($-54^{\circ} \pm 1.5^{\circ}\text{C}$) for 4 hours. Without removal of the panels or mandrels from the cold box, the panels shall be exposed to the flexibility test specified in 4.8.3 and table V and examined for conformance to 3.7.3.4.

4.8.7 Outdoor weather exposure. Panels prepared in triplicate in accordance with 4.6 shall be exposed on an outdoor test rack in Florida facing south at an angle of 45 degrees to the horizon for one year. After the exposure period the coated panels shall be examined for conformance to color (3.7.1.1), Gloss (3.7.1.2), and impact (3.7.2.2) requirements of this specification.

4.8.8 Aliphatic isocyanate. The test to determine that component II of the polyurethane contains only aliphatic isocyanates shall be accomplished by the following spot test: Prepare a 5 percent solution of Parazol FB Extra Dyestuff, color index 37035, in acetone. Spread a thin film or component II on a glass plate and allow to dry for 12 hours. Place one drop of the Parazol FB Extra solution on the film. The presence of toluene-diisocyanate is indicated by the presence of an orange to red coloration. If aromatic isocyanate is not present the surface will stay yellow.

4.8.9 Viscosity. The viscosity of the mixed components shall be determined using a number 2, Zahn cup.

4.8.10 Resistance to taping. Prepare panel in accordance with 4.7 and air dry the coating for 6 hours. Apply a 1-inch wide strip of tape conforming to UU-T-106, type II, adhesive side down, to the panel and press the tape on firmly by hand. Allow the tape to remain in contact with the panel for 1 hour. Remove the tape and visually examine coating immediately for conformance to 3.7.3.7.

4.8.11 Inspection of filled containers. Each sample filled container selected in accordance with 4.4.2 shall be examined for defects of construction relative to the container and the closure, for evidence of leakage, and for all the requirements of section 5.

4.8.12 Pencil hardness

4.8.12.1 Preparation of pencils. A set of drawing pencils (see 6.6) shall be prepared by stripping the wood away from the end approximately 3/8 inch without damaging the lead. The tip of the lead shall then be squared by holding the pencil in a vertical position and moving the lead back and forth over a very fine (320 grit) sandpaper. The tip of the lead shall be squared after each trial.

4.8.12.2 Test procedure. Test panels prepared as specified in 4.7 shall be exposed and cleaned as specified in 3.7.3.5 and shall be placed in a horizontal position and tested immediately at standard conditions. Pencils of increasing hardness shall be pushed across the coated surface of the panel at a 45 degree angle until one is found which will rupture the film (see Figure 1). The number of the next softer pencil from the one that ruptures the coating shall be used to express the pencil hardness.

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. The urethane coating shall be packaged and packed in accordance with TT-P-143. The level of packaging shall be A or C, and the level of packing shall be A, B, or C, as specified (see 6.2). The size of containers shall be as specified in the procurement document (see 6.2).

5.1.1 Kit packaging. The urethane coating shall be supplied as a kit packaged as a unit consisting of equal volumes of pigmented resin base Component I and aliphatic isocyanate reactant Component II to provide the necessary volume of mixed coating purchased. The urethane coating shall be packaged in a one pint, quart or gallon kit and in five gallon kits.

5.2 Marking and labeling. Each component container in every kit and every exterior shipping container shall be marked in accordance with MIL-STD-129. In addition to the marking specified in MIL-STD-129, individual cans and containers shall bear a printed legible label (all labels shall be overcoated with a clear coating for weather proofing) showing the following nomenclature and information as applicable:

Component Identification

Component I - Pigmented Resin Base

Component II - Aliphatic Isocyanate Reactant

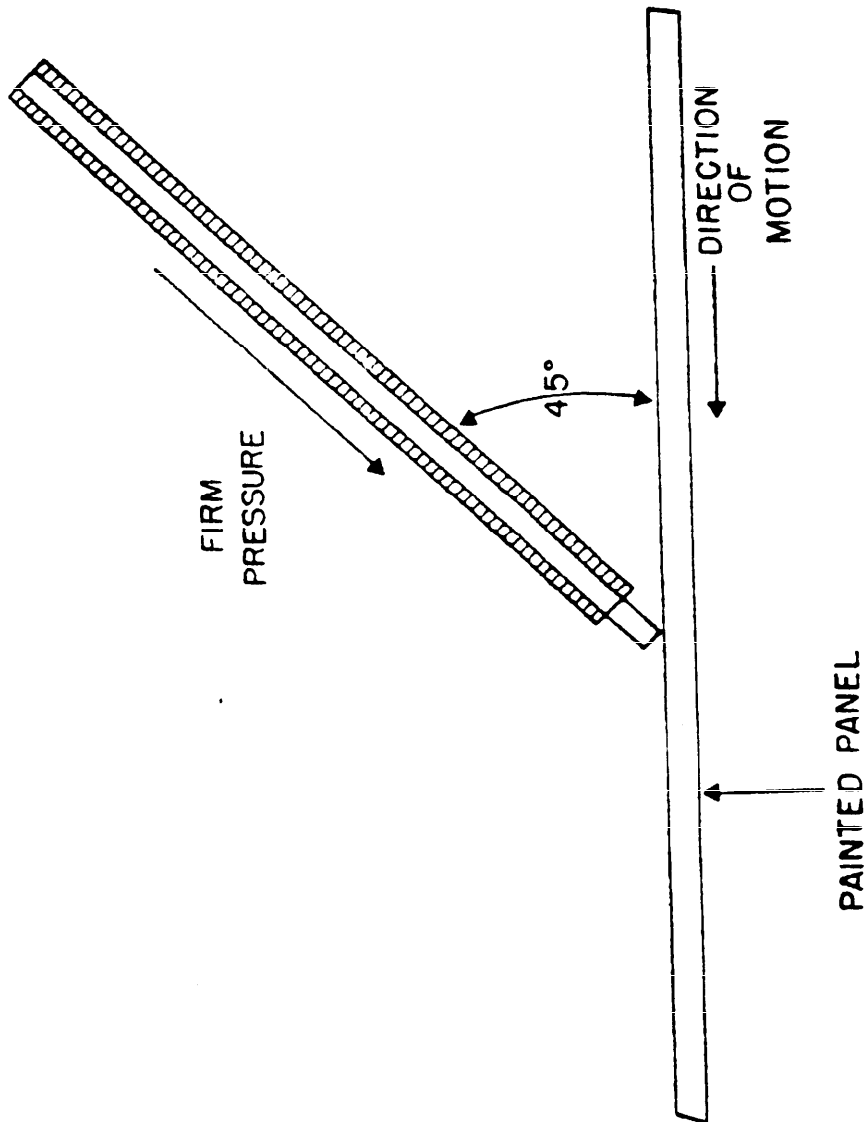


Figure 1. Pencil Hardness Test

TABLE V
Test Methods

Test	FTMS No. 141 method number	ASTM method number	Specification requirement paragraph
A. Component requirements:			
Condition in container	3011.1		
Volatile & Non-Volatile content	4041.1	D-126	3.5.5, 3.6.4 3.6.9
Fineness of grind	4411.1		3.6.8
Moisture content	4081		3.5.6
Viscosity (Component I)		D-562	3.5.7
B. Mixed coating requirements:			
Drying time of coatings	4061.1		3.6.2
Reducibility & dilution stability	4203.1		3.6.4
Odor test	4401		3.6.5
Working properties & surface appearance	4541		3.6.1
* Free Isocyanate			3.6.6
C. Optical properties:			
Hiding power		D-1738	3.7.1.3
Color of pigmented coatings	4250		3.7.1.1
60-Degree specular gloss	6101		3.7.1.2
D. Physical properties:			
Flexibility	6222		3.7.3.4
Impact flexibility	6226		3.7.2.2
Adhesion (wet) tape test	6301.1		3.7.2.1
E. Resistance properties:			
Immersion resistance	6011		3.7.3.5
Heat resistance	6051		3.7.3.3
Salt spray (fog) test	6061	B-117	3.7.3.1
Accelerated weathering	6152		3.7.3.6
Humidity test	6201		3.7.3.2
F. Solvents			
Solvent composition		D-2267	3.5.2, 3.5.4

* See Appendix I

MIL-C-83286B(USAF)

Specification: MIL-C-83286; Type
Manufacturer's Name or Trade Mark
Date Manufactured by Month and Year
Non-Volatile Content
Weight Per Gallon
Mixing, Thinning and Spraying Instructions
Storage Instructions

CAUTION: Keep away from flames. Protective clothing and adequate ventilation must be used during mixing procedure, transfer or application of the coating. Consult the departmental medical service for safe handling instructions.

6. NOTES

6.1 Intended use. The urethane coating covered by this specification is intended for use over MIL-P-23377 epoxy-polyamide primer as a general purpose exterior protective coating for metal surfaces.

6.2 Ordering data. Procurement documents should specify:

- a. Title, number and date of this specification.
- b. Type and component number desired.
- c. Quantity and size of containers required.
- d. Level of packaging and packing (see 5.1 and 5.2).

6.3 Government laboratory. Reference throughout this specification to a Government Laboratory will be interpreted as the Air Force Materials Laboratory, Attn: AFML/MXA, Wright-Patterson AFB, Ohio 45433, unless otherwise specified in the procurement document.

6.4 Chemical film. The MIL-C-81706 material specified in 4.6.2 is Alodine 1200 available from Amchem Products, Inc., Ambler, Pa.

6.5 Special colors. No color number for lusterless tan special as required in paragraph 1.2.b is shown in FED-STD-595. This color shall be furnished to conform to the color requirements of 1.2.b and the camouflage gloss requirements of 3.7.1.2.

MIL-C-83286B(USAF)

6.6 Pencils. A set of Venus drawing pencils (2B, B, HB, F, H, 2H, 3H), manufactured by the Venus Pen and Pencil Corp is satisfactory for the performance of the hardness test specified in 4.8.12.

Custodian:

Air Force - 11

Preparing activity:

Air Force - 11

Reviewers:

Air Force - 71, 84

Project No. 8010-P030

APPENDIX I

DETERMINATION OF FREE HEXAMETHYLENE DIISOCYANATE

MONOMER BY INFRARED SPECTROSCOPY

10. SCOPE

This method is used to determine the amount of unreacted hexamethylene diisocyanate present in product DESMODUR N. The range of applicability is 0.2% free monomer, but can be extended with proper dilutions.

20. PRINCIPLE

The free monomer is removed from the sample by vacuum distillation after the addition of a carrier solvent. The distillate is diluted with carbon tetrachloride and its spectrum obtained in the wavelength region of 2480-2000 cm^{-1} . The absorption band at 2265 cm^{-1} is measured and the value obtained is converted to concentration of free hexamethylene diisocyanate with the aid of a calibration curve.

30. EQUIPMENT AND REAGENTS

30.1 Double beam infrared spectrometer, Perkin Elmer Model 225 or equivalent.

30.2 Two matched NaCl cuvettes, 0.9 mm path length.

30.3 Distillation apparatus (see Figure 1, from ASTM D2615-677).

30.4 Volumetric flasks, 100 ml, 10 ml.

30.5 Analytical balance.

30.6 Oil bath (600 ml beaker with mineral oil and equipment with beaker mantle or hot plate for heating).

30.7 Vacuum pump, manometer, Dewar flask and safety shield.

30.8 Purified hexamethylene diisocyanate.

30.9 Carbon tetrachloride, spectral grade.

30.10 Mixed solvent.

Reflux 4 liters of Cellosolve acetate + over 200 ml toluene diisocyanate for 1 hour. Mix equal volumes of diphenyl ether and purified Cellosolve acetate. Add approximately 25 g of silica gel (type 08, 12-18 mesh) for every 100 ml of the mixed solvent. Shake and allow to stand overnight before using.

40. PROCEDURE

Instrument Settings:

slit	manual, 250 μ
gain	manually set at 2260 cm^{-1}
pen traverse time	10 seconds
pen response	2
scan speed	2
scale selector	1
range scanned	2480-2000 cm^{-1}

Standardization:

40.1. Prepare five standard solutions having concentration of 10 mg, 20 mg, 30 mg, 40 mg, and 50 mg of hexamethylene diisocyanate in 100 ml of carbon tetrachloride.

40.2. With the matched NaCl cuvettes, record the spectra of the standard solutions in the wavelength region of 2480-2000 cm^{-1} , using pure carbon tetrachloride in the reference beam.

+Union Carbide Chemicals Company, polyurethane grade.

40.3. Draw a tangent through the absorption minima at ~ 2450 cm^{-1} and ~ 2100 cm^{-1} on each curve, then measure the peak height of the absorption maximum at 2265 cm^{-1} from this tangent line.

40.4. Plot the absorption values for the standard solutions as a function of their concentrations expressed as mg/10 ml of carbon tetrachloride.

Analytical Procedure

40.5. Weigh approximately 1.0 g of sample accurately (± 0.1 mg) into a dry vial and add 1.0 g of mixed solvent weighed accurately (± 1 mg). Cap tightly with a polyethylene lined screw cap and completely dissolve by shaking.

40.6. Weigh exactly about 0.3-4.4 g of sample solution into the tared distillation thimble and stopper immediately.

40.7. Attach the thimble to the distillation assembly, and arrange the apparatus to immerse the U-tube condenser in the dry ice-acetone bath contained in a Dewar flask.

40.8. Evacuate the system to 1-3 mm Hg pressure and maintain this pressure for 5 minutes before proceeding.

40.9. Gradually raise the oil bath which has previously been heated to $100^{\circ} \pm 5^{\circ}\text{C}$, over the sample thimble and up to, but not touching the bulbous portion of the air condenser. Maintain the temperature at $95-105^{\circ}\text{C}$ for 20 minutes \pm 30 seconds.

40.10. Lower the oil bath, release the vacuum and detach the distillation assembly, leaving the U-tube condenser in the dry-ice acetone bath. Wipe the oil from the inner joint of the air condenser. Hold the air condenser with the head joint upward and carefully rinse the head joint with carbon tetrachloride taking care to avoid picking up portions of residual resin from the column. Quantitatively transfer the rinsings and the contents of the U-tube condenser to a 10 ml volumetric flask. Dilute to the mark with additional carbon tetrachloride.

40.11. The spectrum of the solution is recorded at $2480-200\text{ cm}^{-1}$, a baseline constructed as before and the peak at 2265 cm^{-1} is measured. (If the absorption is too strong, the sample can be diluted with additional carbon tetrachloride; however, this must be taken into account in the calculations below.)

50. CALCULATIONS

Calculate the free monomer as follows:

$$\% \text{ Hexamethylene diisocyanate monomer} = \frac{C}{W \times 10}$$

C = mg/10 ml hexamethylene diisocyanate from the standard curve.

W = sample weight in grams used in the distillation procedure.

Or Alternatively, as % NCO expressed on the basis of 100% solids:

$$\% \text{NCO, 100\% solids basis} = \frac{C \times 5}{W \times (\% \text{ solids in solution})}$$

Note: Using this equation, express "% solids in solution" as %, e.g., 50 and not as the decimal equivalent.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

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5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

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